



Naval Facilities Engineering Service Center
Port Hueneme, California 93043-4370

Special Publication SP-2092-SHR

GUIDANCE DEVELOPMENT: THIN FILM AND EPOXY MORTAR FLOORING SYSTEMS



by

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EXECUTIVE SUMMARY

Two Naval Facilities Engineering Command (NAVFAC) Guide Specifications (NFGS) were developed and are presented in the Appendices: A) NFGS-09611 "Thin Film Flooring System for Aircraft Maintenance Facilities," and B) NFGS-09612 "Epoxy Mortar Flooring System for Aircraft Maintenance Facilities." Private industry and qualified Navy personnel have reviewed the specifications and beneficial comments have been inserted where appropriate. Future work includes presenting specifications to NAVFAC Code 15 (Criteria Office) for conversion into a SPECSINTACT format.

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INTRODUCTION

The objective of this effort was to develop two floor coating specifications for use in aircraft maintenance facilities: 1) Thin Film Flooring System, and 2) Epoxy Mortar Flooring System. This work was in response to a request from the Airfield Criteria Manager and was funded in part by the Naval Facilities Engineering Service Center's (NFESC) Hangar Floor Coating Program.

GUIDANCE DEVELOPMENT

Two Naval Facilities Engineering Command (NAVFAC) Guide Specifications (NFGS) were developed and are presented in the Appendices: A) NFGS-09611 "Thin Film Flooring System for Aircraft Maintenance Facilities," and B) NFGS-09612 "Epoxy Mortar Flooring System for Aircraft Maintenance Facilities." Private industry and qualified Navy personnel have reviewed the specifications and beneficial comments have been inserted where appropriate. Future work includes presenting specifications to NAVFAC Code 15 (Criteria Office) for conversion into a SPECSINTACK format.

ACKNOWLEDGEMENT

The author wishes to thank Mr. Joe Brandon (Coating Specialist, LANTDIV) for technical review of the specifications.

APPENDIX A

NFGS-09611

**"THIN FILM FLOORING SYSTEM FOR
AIRCRAFT MAINTENANCE FACILITIES"**

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
GUIDE SPECIFICATION

NFGS-09611
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NFGS-09611

THIN FILM FLOORING SYSTEM
FOR AIRCRAFT MAINTENANCE FACILITIES

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SECTION 09611

THIN FILM FLOORING SYSTEM
FOR AIRCRAFT MAINTENANCE FACILITIES

9/00

NOTE: This guide specification covers the requirements for a three-coat, liquid flooring system with reflective urethane topcoats, slip resistance, and joint work. The thin film flooring system is appropriate for use on: aircraft maintenance hangars, equipment maintenance shops, and all other industrial floors where resistance to abrasion and fuel is required. Installation costs: \$2.00 - \$4.50 square foot. Nominal thickness: 0.375 mm 15.0 mils. Can be rejuvenated by replacing urethane topcoats, and non-skid, only. Approximate service life: Urethane topcoating with non-skid grit at three or more years. The flooring system is neither conductive nor Electro-Static Dissipative (ESD), however, either formulation is easily designed upon request. This specification is not for use in overcoating existing sound coating systems.

NOTE: Prior to the flooring system's installation, a concrete condition assessment in accordance with the Naval Facilities Engineering Service Center's (NFESC) Users Guide (UG)-2036-SHR is highly recommended. The condition assessment is designed to identify problem floors and eliminate premature flooring failures produced by: 1) Coating concrete with low surface strength, 2) Coating concrete with high levels of surface contamination (oils, fuels, fats, waxes, etc.), and 3) Coating concrete with a high rate of Moisture Vapor Emission (MVE). The thin film flooring system is suitable for application to: A) "Smooth" concrete surface texture, B) Concrete with a rate of MVE no more than 3.0 pounds moisture/24 hours, 1000 square feet (ASTM-F-1869), C) Concrete with surface strength greater than 200 psi (ASTM-D-4541), and D) Concrete with fuel/oil contamination to a depth no more than 1/4 inch.

NOTE: If a concrete floor has a rate of Moisture Vapor Emission (MVE) more than 3.5 pounds moisture/24 hours, 1000 square feet (ASTM-F-1869), a layered Moisture Reducing System (MRS) shall be applied prior to the application of the thin film flooring system. The MRS shall be compatible with the submitted flooring system and approved/warranted by the manufacturer of the thin film flooring system. The MRS shall be applied to shot blasted concrete and reduce the rate of MVE to less than 3.0 pounds moisture/24 hours, 1000 square feet. MRSs can employ combinations of concrete sealers, specific epoxies, and moisture insensitive grouts, with or without mesh. MRSs are available from the following partial list of thin film flooring system vendors: Tennant (800) 553 - 8033, Stonhard (856) 779 - 7500, General Polymers (800) 543 - 7694. Moisture Vapor Emission Test Kits (MVETK) are available from the following partial list of vendors: Floor Seal (800) 295 - 0221, Sinak (619) 231 - 1771, General Polymers (800) 543 - 7694.

NOTES: Include Section 03930 "Concrete Rehabilitation" for repair of minor spalls and surface deterioration to depths less than three inches. Specify epoxy mortar for repairs to depths no more than two inches. Specify epoxy concrete for repairs to depths from one to three inches. Repairs to depths greater than one inch shall contain a rectangular geometry with saw cut edges. Repairs shall be finished to resemble surrounding concrete using a stainless steel trowel.

Include Section 02983 "Partial Depth Patching of Rigid Pavements" for repair of large spalls and severe deterioration to depths from three to six inches. Specify Portland Cement Concrete (PCC) with less than 0.45 water-cement ratio, light steel trowel finish, and cure using plastic coated burlap. Geometry for repairs shall be rectangular with saw cut edges to a nominal repair depth of six inches. PCC repair shall cure for approximately 30 days prior to the application of the flooring system. Do not cure repairs using liquid membrane-forming compounds.

For repair of spalls and severely distressed concrete to depths greater than six inches, seek material guidance from Section 03300 "Cast-In-Place Concrete" and procedural guidance from the American Concrete Pavement Association (ACPA) Guideline TB-002.02P "Concrete Paving Technology - Guidelines for Full-Depth Repair." Repair base shall contain a minimum of two inches of clean, non-reactive concrete sand over a suitable vapor retarder (0.25 mm 10 mils polyethylene sheeting). Repairs shall be finished by light steel trowel and cured using plastic coated

burlap. Repairs shall cure for approximately 30 days, or more, prior to the application of the flooring system. Do not cure repairs using liquid membrane-forming compounds.

Curled and/or settled slab ends with joint surfaces displaying more than 1/8 inch difference in vertical height shall be scarified level. Resulting surfaces shall contain a height difference no more than 1/16 inch and a surface texture equal ICRI-CSP 4.

NOTE: Include Section 03300 "Cast-In-Place Concrete" for new concrete slab construction. Measures shall be employed to control the rate of base, subbase, and subgrade Moisture Vapor Emission (MVE) to total no more than 3.0 pounds moisture/24 hours, 1000 square feet when measured on the slab's surface (ASTM-F-1869). Improper MVE controls have produced numerous premature coating failures. In addition to appropriate subbase drainage, specify a minimum of two inches of clean, non-reactive concrete sand over no less than 0.25 mm 10 mils of polyethylene sheeting (ASTM-D-4397) with sealed lap joints. Specify concrete mix to be free of both accelerators containing calcium chloride and other sources of chloride ion contamination. Specify two passes of a light power troweled finish and cure using plastic coated burlap or equal method. Do not cure concrete using liquid membrane-forming compounds. Do not specify surface hardeners or dry shake finish (NFGS-09965). Approximately 60 days following the concrete pour and prior to the installation of the flooring system, test concrete for rate of MVE and confirm rate is no more than 3.0 pounds moisture/24 hours, 1000 square feet (ASTM-F-1869). Consult ACI 224.3R "Joints in Concrete Construction," ACI 302.1R "Guide for Concrete Floor and Slab Construction," ACI 360R "Design of Slabs on Grade," and other appropriate construction guidance.

NOTE: Where tile is to be removed prior to the application of flooring system, test both tile and mastic for the presence of asbestos. If asbestos is detected, include NFGS-S-13281 "Engineering Control of Asbestos Containing Materials" for removal and disposal.

NOTE: If flooring system is to be applied to warehouse floors with heavy fork lift traffic, a semi-flexible joint sealant is required in lieu of the specified flexible sealant. Use a semi-flexible epoxy sealant with approximately 90 % elongation.

Semi-flexible sealants shall not be used in areas exposed to exterior temperatures.

NOTE: Include Section 01450 "Quality Control."

NOTE: Include Section 01575 "Temporary Environmental Controls." This Section defines fugitive dust, generated waste, hazardous materials, hazardous substance, hazardous waste, solid waste, construction and demolition (CD) debris, and liquid waste, and contains documentation for dangerous waste profiles, waste information sheet, waste identification document, waste generation record, landfill disposal form, and hazardous material reporting.

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. Within the specification, publications are referred to by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 679	(1997) Standard Test Method for Tack-Free Time of Elastomeric Sealants
ASTM C 884	(1998) Standard Test Method for Thermal Compatibility between Concrete and Epoxy-Resin Overlay
ASTM D 412	(1998) Standard Test Method for Vulcanized Rubber and Thermoplastic Rubber and Thermoplastic Elastomers - Tension
ASTM D 638	(1999) Standard Test Method for Tensile Properties of Plastics
ASTM D 1308	(1998) Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 2240	(1997) Standard Test Method for Rubber Property-Durometer Hardness
ASTM D 2621	(1995) Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
ASTM D 2697	(1998) Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings

ASTM D 3335	(1999) Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3718	(1999) Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
ASTM D 3925	(1996) Standard Practice for Sampling Liquid Paints and Related Pigmented Coatings
ASTM D 4541	(1995) Standard Test Method for the Pull-off Strength of Coatings Using Portable Adhesion Testers
ASTM D 6237	(1998) Standard Guide for Painting Inspectors (Concrete and Masonry Substrates)
ASTM E 11	(1995) Standard Specification for Wire Cloth and Sieves for Testing Purposes
ASTM F 1869	(1998) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1000	Air Contaminants
29 CFR 1926.59	Hazard Communication

FEDERAL SPECIFICATIONS (FS)

FED-STD-595	(Rev. B) Colors Used in Government Procurement
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INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI-03732	(1997) Technical Guideline: "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-TU 2	(1997) Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment
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1.2 SUBMITTALS

NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significantly to

merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-04 Samples

Joint Sealant; G

Thin Film Flooring System; G

White Aluminum Oxide Non-Skid Grit; G

SD-06 Test Reports

Joint Sealant; G

Thin Film Flooring System; G

Primer; G

Urethane Topcoat; G

White Aluminum Oxide Non-Skid Grit; G

Patch Test Demonstration; G

Daily Inspection Report; G

Adhesion Testing; G

SD-07 Certificates

Work plan; G

Flooring System Applicator Qualifications; G

Joint Sealant; G

Thin Film Flooring System; G

Warranty; G

SD-08 Manufacturer's Instructions

Joint Sealant; G

Thin Film Flooring System; G

Water-Based Alkaline Degreaser; G

SD-11 Closeout Submittals

Inspection Logbook; G

1.3 QUALITY ASSURANCE

1.3.1 Test Reports

1.3.1.1 Joint Sealant

Submit test results that confirm sealant complies with the requirements of Table 1a. Samples must have been tested within the last three years.

1.3.1.2 Thin Film Flooring System

Submit test results that confirm the thin film flooring system complies with the requirements of Table 1b. Samples must have been tested within the last three years.

1.3.1.3 Primer

Submit test results that confirm the primer complies with the requirements of Table 1c. Samples must have been tested within the last three years.

1.3.1.4 Urethane Topcoat

Submit test results that confirm the urethane topcoat complies with the requirements of Table 1d. Samples must have been tested within the last three years.

1.3.1.5 Daily Inspection Report

Submit one copy of the daily inspection report to the Contracting Officer within 24 hours of the date recorded.

1.3.2 Certificates

1.3.2.1 Work Plan

Submit schedule to complete work within approximately twelve (12) consecutive days. Submit a written plan describing in detail all phases of coating operations. Address work sequencing, surface preparation, flooring system application, recoat and cure time projections, as well as how each step will be controlled, tested, and evaluated. Address safety measures, work scheduling around weather, and record keeping. Contractor shall assign one supervisor to the job who is to remain on site throughout all phases of work and who is to act as the contractor's primary point of contact. This person shall be identified in the submitted schedule.

1.3.2.2 Flooring System Applicator Qualifications

Minimum requirements for the installation contractor are as follows: Installation contractor shall have completed three or more jobs within the past two years applying the specified materials to concrete surfaces in which the total area exceeds 200,000 square feet. Contractor shall submit documentation listing location of work, point of contact at job site, total square footage of applied materials, listing of both materials and equipment used, and validation from coating manufacturer documenting quantity of materials purchased per job for work totaling 200,000 square feet within the past two-years. In addition to the above requirements, installation contractor shall be certified by the material manufacturer(s) to install the submitted coatings and sealant. Submit copy of certificates.

1.3.2.3 Joint Sealant

Submit literature documenting the past performance of the sealant's use in automotive and/or aircraft maintenance shops. Minimum requirements are two or more maintenance shops with joint work totaling 10,000 linear feet whereby the sealant has performed for two years with less than 1 % combined sealant failures and defects. Sealant manufacturer shall list location of shops, total linear feet of sealant applied per shop, shop point of contact, date sealant was applied, and the name of the installed sealant material.

1.3.2.4 Thin Film Flooring System

Submit literature documenting the past performance of the coating system's use in aircraft maintenance shops and over floors with high rates of Moisture Vapor Emission (MVE). Minimum requirements are two or more aircraft maintenance shops totaling 34,000 square feet whereby the coating system has performed for two years with less than 0.05 % combined premature coating failures, material defects and surface discoloration: no more than 0.03 % discoloration from aviation chemicals, tire plasticizers, and UV exposure. Provide a minimum of two additional case histories where successful installation occurred on floor slabs with no less than 3.5 lbs moisture/24 hours, 1000 square feet. Coating manufacturer shall list location of shops, total coated area per shop, shop point of contact, date coating system was applied, successful installation to concrete with high MVE, and the names of the installed coating materials.

1.3.2.5 Warranty

Materials and workmanship shall be warranted by the "Installation Contractor" for a minimum period of one-year following coating and sealant application. The following terms and conditions form a part of the warranty. If the applied coating system develops either blisters (chemical), checks, softening, or lifting within one-year following application, each area shall be reworked by installation contractor at contractor's expense. The following conditions are excluded from the warranty: A) Reflective concrete cracking, flooring system mirrors cracks in concrete, B) Cosmetic imperfections due to scratching and gouging, C) Application to metallic concrete finishes (NFGS-09965), and D) Application to concrete with a rate of Moisture Vapor Emission (MVE) > 3.5 pounds moisture/1000 square feet, 24 hours. If the coating system's adhesion is in question, one adhesion test shall be performed per 100 square feet as described in the Article entitled "ADHESION TESTING." To satisfy the warranty, each adhesion test shall produce cohesive failures within the concrete or display intercoat adhesion of at least 400 psi. Each area failing to meet adhesion requirements shall require two additional adhesion tests to confirm results. Within the warranty period, all areas unable to meet adhesion requirements shall be removed to sound material and reworked. There shall be 0 % sealant failures within one year. Within the warranty period, all sealant material with chemically attacked surfaces and/or lifting from joint walls shall be removed and reworked. Topcoat cracking over sealant is excluded from warranty.

1.3.3 Product Data

1.3.3.1 Joint Sealant

Submit manufacturer's printed instructions to include detailed application procedures, minimum and maximum application temperatures, and curing

procedures. In accordance with 29 CFR 1926.59, include Material Safety Data Sheets (MSDS) for the sealant to be used at the job site.

1.3.3.2 Thin Film Flooring System

Submit manufacturer's printed instructions to include detailed mixing, minimum and maximum application temperatures, acceptable atmospheric and/or interior climatic conditions, application procedures, curing procedures, and procedures for maintenance cleaning of flooring system. Provide explicit instructions detailing surface preparation, recoat windows and remedial actions in case recoat windows are missed, and, if applicable, solvent-wiping between coats with acceptable types and grades of solvents. In accordance with 29 CFR 1926.59, include MSDSs for the coatings to be used at the job site.

1.3.3.3 Water-Based Alkaline Degreaser

Submit manufacturer's printed instructions to include detailed mixing, rate of dilution, application procedures, and rinsing procedures. In accordance with 29 CFR 1926.59, include MSDSs for the water-based alkaline degreaser to be used at the job site.

1.4 DELIVERY, STORAGE, AND HANDLING

Coatings and sealant shall be stored in spaces with temperatures from 40 to 75 degrees F. Materials on site shall be inspected for damage prior to use. Packaged materials in dented, rusty, or leaking containers shall be returned to manufacturer. Materials with an expired shelf life shall be returned to manufacturer, tested, and if compliant, re-issued a shelf life extension.

1.5 COATING HAZARDS

NOTE: Include either Section 01525 "SAFETY REQUIREMENTS" or prepare instructions detailing each element of safety for use with this section.

Ensure that employees are trained in all aspects of the safety plan. The coating manufacturer's written safety precautions shall be followed throughout mixing, application, and curing of coatings. Comply with respiratory protection requirements in 29 CFR 1910.134 and safe levels of airborne contaminants in 29 CFR 1910.1000.

1.6 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM-D-4541, ASTM-D-6237, SSPC-TU 2, and ICRI-03732, including replica standards ICRI-CSP 1 through ICRI-CSP 9, at the job site.

1.7 PATCH TEST DEMONSTRATION

NOTE: This is a very important part of the submittal process. While it is unusual to require a test patch prior to the submitted coating system's approval, this flooring system is unusual in that it is required to provide extended, uninterrupted performance. A demonstration of contractor claims,

especially under conditions to be encountered in the specific project, is considered necessary.

If customer dislikes level of non-skid grit, adjustments to the specification can be made. Grit coarser than #60 aluminum oxide is not recommended. On architectural floors, non-skid grit broadcast rates can range from none to approximately half the specified level.

Prior to the submitted flooring system's approval, the installation contractor shall apply the complete coating system to a ten-foot by ten-foot square section of concrete as prepared in accordance with Part 3 "EXECUTION." Within this area, three adhesion tests shall be performed as described in the Article entitled "ADHESION TESTING." If concrete surface preparation was insufficient, contractor shall apply an additional coating system patch to properly prepared concrete followed by the above adhesion testing. If adhesion results are unacceptable for both the topcoats and the primer, contractor shall submit a new coating system manufactured by a different coating vendor. A patch of the new coating system shall be applied and subjected to the above requirements for adhesion prior to approval. If customer dislikes non-skid grit application, adjustments to the specification may be made. Grit coarser than #60 aluminum oxide is not recommended. Immediately following adhesion testing, the test patch shall be removed and sanded flush with surrounding concrete.

PART 2 PRODUCTS

NOTE: The specified materials are not appropriate for use in primary chemical containment, secondary chemical containment, or on floors subjected to spills from concentrated acids, bases, and organic solvents. Consult with the Naval Facilities Engineering Service Center's (NFESC) Paints and Coatings Center of Expertise for alternative coating systems to suit specific Navy needs.

2.1 JOINT SEALANT

The joint sealant shall be formulated to exhibit the properties as listed in Table Ia.

2.2 THIN FILM FLOORING SYSTEM

A three-coat industrial flooring system consisting of primer and two urethane topcoats. The applied system shall display a total Dry Film Thickness (DFT) ranging from 0.013" to 0.020" and contain broadcasts of aluminum oxide nonskid grit. The complete flooring system shall be formulated to exhibit the properties as listed in Table Ib. Additional requirements for primer coat and urethane topcoat are listed below.

2.2.1 Primer Coat

In addition to the requirements of the thin film flooring system, the primer coat shall be formulated to exhibit the properties as listed in Table Ic.

2.2.2 Urethane Topcoat

In addition to the requirements of the thin film flooring system, the urethane topcoat shall be formulated to exhibit the properties as listed in Table Id.

2.3 WHITE ALUMINUM OXIDE NON-SKID GRIT

Size #60, dust-free (washed and dry), minimum 99% pure, having the following sieve analysis (ASTM-E-11):

Sieve No. 40	100 % passing
Sieve No. 50	15 - 30 % retained
Sieve No. 60	70 - 85 % retained
Sieve No. 70	0 - 15 % retained

PART 3 EXECUTION

3.1 COATING SAMPLE COLLECTION

The Contracting Officer and QC Manager shall witness all material sampling. The Contracting Officer shall be notified a minimum of three days in advance of sampling. Obtain liquid samples of each component of primer and topcoat by random selection from sealed containers and in accordance with ASTM-D-3925. Samples may be either individual cans of liquid material or one-pint quantities of properly mixed, extracted, and sealed liquid material. Identify samples by designated name, specification number, batch number, project contract number, sample date, intended use, and quantity involved. When the applied coating system has met the requirements defined in the Article entitled "ADHESION TESTING," coating samples shall be returned to the installation contractor for proper disposal.

3.2 TILE AND TILE ADHESIVE REMOVAL

NOTE: Delete "Tile and Tile Adhesive Removal" if
concrete is not tiled.

Remove 100 % of tile employing a combination of one or more of the following techniques: chipping, scraping, sanding, scarification, high-pressure water, and various hand tools. Remove 100 % of tile adhesive using solvents and power scrubbing. Remove residual contamination using hot potable water under a minimum of 4,000 psi pressure. Resulting surfaces shall appear visually clean and display the gray color of concrete.

3.3 JOINT MATERIAL REMOVAL, RE-SAW CUTTING, CRACK CHASING

NOTE: Hairline cracks having no more than 1/8 inch width are typically not repaired. However, cracks greater than 1/8 inch width can be chased to a minimum depth of 1/2 inch and sealed using the procedures and materials specified for joints. Cracks more than 3/4 inch width can be repaired using either epoxy mortar and/or epoxy concrete. Sealed cracks will assist in protecting the subbase against chemical migration.

Remove 100 % of the existing material in all joints including material bonded to joint walls and base. Rigid material may require the use of saw cutting equipment to remove. Joints may be widened by up to 1/8 inch when re-saw cutting. Concrete cracks identified for repair shall be chased and opened to a minimum depth of 1/2 inch below crack surface. Resulting chased crack(s) shall contain smooth vertical walls.

3.4 DEGREASING

On both coated and uncoated concrete, degrease entire floor by scrubbing using a solution of hot potable water, 120°F - 170°F, and a concentrated water-based alkaline degreaser. Two complete degreasing cycles shall be performed on entire floor surface. Allow solution to soak into surfaces prior to scrubbing and remove using hot potable water under a minimum of 4,000 psi pressure. Rinsing shall be complete when the rinse water appears clear. If the industrial detergent is not biodegradable, all rinse water shall be collected and disposed of as hazardous waste. Squeegees and shop vacuums may be used to collect pooling rinse water. Fans may be used to aid drying of floor surfaces.

3.5 COATING SYSTEM REMOVAL

NOTE: Delete "Coating System Removal" if concrete is uncoated.

Remove 100 % of the existing coating system employing a combination of one or more of the following techniques: shot blasting, chipping, scraping, sanding, scarification, high pressure water blasting, and various hand tools. The use of impact tools such as scabblers may be used to remove unsound epoxy mortar flooring systems. In general, a coating system can not be completely removed by shot blasting and, to attain 100 % coating removal, requires combinations of one or more of the above techniques.

3.6 SURFACE PREPARATION

Shot blast entire floor to produce a level of coarseness equal to ICRI-CSP 3. Each pass of shot blasting shall be slightly overlapped by 1/4 inch to 1/2 inch. New shot shall be added to shot blasting equipment prior to blasting. Concrete surfaces inaccessible to shot blasting, base of perimeter walls and under secured equipment, shall be prepared using diamond disk grinding and/or light scarification to produce a level of coarseness equal to ICRI-CSP 2, ICRI-CSP 4, respectively. Resulting surfaces shall appear visually clean and contain the appropriate level of surface coarseness. If the resulting level of cleanliness can not be determined, place numerous drops of water on surfaces that appear visually contaminated. If the water drops soak into concrete, surfaces are free of hydrocarbon contamination (oils, grease, skydrol). If the water drops bead up and do not flatten out, surfaces require additional degreasing as detailed in the Article entitled "DEGREASING." Shot blasting coarse concrete and/or broom finished concrete can produce a level of coarseness equal to ICRI-CSP 5: a best effort attempt shall be employed to minimize over shot blasting coarse concrete. If coarse concrete is encountered, shot blasting to a level of coarseness equal to ICRI-CSP 5 is acceptable; however, extremely coarse concrete can require resurfacing prior to the flooring system's

installation. Sweep, vacuum, and run a high powered magnet over all surfaces to be coated.

NOTE: At this point in the installation sequence, minor spalls and surface deterioration to depths less than three inches can be repaired. Use epoxy mortar for repairs to depths no more than two inches. Use epoxy concrete for repairs to depths from one to three inches. Repairs to depths greater than one inch shall contain a rectangular geometry with saw cut edges. Repairs shall be finished to resemble surrounding concrete using a stainless steel trowel. Include Section 03930 "Concrete Rehabilitation" if concrete repairs of this nature are required.

3.7 JOINT TREATMENT

The "Conventional Sealed Joint" as detailed in Figure 1 of SSPC-TU 2 shall be used to seal joints. Care shall be taken to reduce contamination from equipment and foot traffic. Floor access shall be limited to essential contractor personnel. Confirm joint surfaces are sufficiently clean.

3.7.1 Install Backer Rod

Install a continuous length of round, closed-cell polyethylene backer rod into each joint using a backer rod tool. For 1/2 inch, 3/8 inch, and 1/4 inch wide joints, backer rod shall be placed to a depth of 3/8 inch (depth equals the distance from the concrete's surface to the highest point on the backer rod). For joints greater than or equal to 3/4 inch width, place backer to a depth of 5/8 inch below the concrete's surface. Backer rod shall fit tight between joint walls (30 % compression). All backer rod that is installed using either the incorrect size (loose fit) or at the incorrect depth shall be removed and reinstalled. Following backer rod installation, apply painter's tape to surfaces adjacent joints to protect from sealant.

3.7.2 Sealant Application

Apply sealant directly into joints using a bulk-caulking gun. At room temperature, the resulting sealant application shall exhibit a concave recess between 1/8 inch to 1/32 inch below the concrete's surface. Cured sealant remaining either flush or greater shall be removed and reapplied by contractor at contractor's expense. Following sealant application, remove painter's tape and sealant drips on concrete surfaces. Prior to the application of coatings, sealant shall cure a minimum of 24 hours.

3.8 PRE-APPLICATION TESTING FOR CONTAMINATION

Spot check surfaces for oil/grease contamination using the water break test. At a rate of 5 tests per 1000 square feet, place one to two drops of water onto surfaces and observe for beading. Test all other surfaces that show visible signs of potential contamination. Surfaces displaying water beading shall receive additional degreasing in accordance with the Article entitled "DEGREASING."

3.9 COATING APPLICATION

NOTE: The epoxy primer shall contain the same color, either white or ultra-light gray, as the selected topcoats. Ultra-light gray is preferred to white.

Prior to the application of the flooring system, vacuum flooring space.

3.9.1 Primer Application

Apply primer to flooring space at 7.0 mils to 15.0 mils Dry Film Thickness (DFT). If the prepared concrete resembles an ICRI-CSP 3 surface, apply the primer at a minimum of 7.0 mils DFT. If the prepared concrete resembles an ICRI-CSP 5 surface, apply the primer at a maximum of 15.0 mils DFT. The previously applied sealant may be lightly coated.

3.9.2 Non-skid Grit Broadcast

NOTE: Aircraft hangars servicing light aircraft with weight less than 40,000 pounds may require a higher loading of non-skid grit. Up to one additional pound per 100 square feet of the specified non-skid grit can be broadcast into the second topcoat application. The additional grit will assist in towing aircraft under wet conditions; however, the additional grit will decrease coating aesthetics.

On either warehouse or architectural floors, considerably less non-skid grit may be appropriate. Broadcast rates can range from none to less than 1.0 pound per 1000 square feet.

Broadcast non-skid grit at a rate of 1.5 pounds per 100 square feet into the first urethane topcoat and backrolled. The floor shall be mapped into 600 square foot sections where 9.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 square foot section. Broadcast non-skid grit at a rate of 1.0 pound per 100 square feet into the second urethane topcoat and backrolled. The floor shall be mapped into 600 square foot sections where 6.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 square foot section.

3.9.3 Application of Topcoats

Two coats of urethane topcoat shall be applied directly to the epoxy primer and with two broadcasts of white aluminum oxide non-skid grit.

3.9.3.1 First Topcoat

Apply urethane topcoat at 2.5 mils to 3.0 mils Dry Film Thickness (DFT). Stripe coat perimeter edges and around equipment footings. When the correct Wet Film Thickness (WFT) has been applied per 600 square feet of area, immediately and evenly broadcast non-skid grit directly into the urethane topcoat and backroll in two directions. Sealant is to be lightly coated.

3.9.3.2 Second Topcoat

Apply a second coat of the urethane topcoat at 2.5 mils to 3.0 mils DFT. Stripe coat perimeter edges and around equipment footings. When the correct WFT has been applied per 600 square feet of area, immediately and evenly broadcast non-skid grit directly into the second topcoat of urethane and backroll in two directions. The adhesion of the coating system shall be tested in accordance with the Article entitled "ADHESION TESTING."

3.9.3.3 Walkway Stripe

NOTE: Delete paragraph if walkway stripe is not required.

Place the walkway stripe according to Government drawings. When the second topcoat is within its recoat window, apply a walkway stripe of the red/orange urethane topcoat at 3.0 mils DFT. Lightly broadcast non-skid grit into the wet walkway stripe. Solvent resistant tape shall be used to protect the floor coating against stripe coat bleed. A thin clear coat of either epoxy or urethane may be required to prevent stripe coat bleed prior to the full application of the colored stripe coat. The red/orange topcoat shall completely hide, in one coat, the topcoat color. If insufficient hiding occurs, apply one additional coat of the walkway stripe coating.

3.10 CURING

Installed materials shall cure and display performance equal to manufacturer's product literature. Improperly cured material shall be removed and reapplied by contractor at contractor's expense.

3.11 FIELD TESTS AND INSPECTION

3.11.1 Coating Inspector

NOTE: Insert directly into Section 01450 requirement for NACE Coating Inspector. See Appendix A for instructions on modifying Section 01450. The NACE Coating Inspector will act as QC Specialist.

The Coating Inspector shall be considered a QC Specialist, work for the QC Manager, and be qualified in accordance with Section 01450. The Coating Inspector will be present during all field tests, surface preparation, flooring application, initial cure of the flooring system, and during all flooring repair work. The Coating Inspector will provide all tools/equipment necessary to perform field tests and inspection. The Coating Inspector will be responsible for field tests and the specified level of inspection.

3.11.2 Inspection

The Coating Inspector shall document weather conditions, job site occurrences, and report conditions and occurrences potentially detrimental to the flooring system. The listed inspection requirements are in addition to the QC inspection and reporting requirements defined in Section 01450.

The Coating Inspector shall prepare a project reference sheet outlining all requirements, tests, test methods, and evaluation criteria, and hold regular meetings with contractor personnel, including shot blasting operators and applicators, to review requirements/evaluation criteria for upcoming work prior to execution. At the start of coating operations and every 1.0 hour following until daily work is complete, record air temperature, substrate temperature, and relative humidity. Following the application of each coat, inspect surfaces for improperly cured material, blisters, inadequate and/or excessive coating thickness, and other defects. Document each inspection, test, non-compliant areas, and location of each non-compliant area. List method of evaluation, evaluation criteria, areas requiring rework, and all other pertinent observations.

3.11.2.1 Daily Inspection Report

Submit to the Contracting Officer one copy of the daily inspection report completed each day when performing work under this Section. Use Appendix X1 "Inspection Checklist" of ASTM-D-6237 to monitor daily activity and to assist in preparing the daily inspection report. Note each non-compliant issue and each issue identified for rework in accordance with the QC documentation procedures of Section 01450. Use of forms containing entry blocks for all required data is encouraged. The data shall be legible and presented in a professional format. Submit report within 24 hours of the report date.

3.11.2.2 Inspection Logbook

The Inspection Logbook shall be a continuous record of all daily activity related to this Section. The logbook shall contain the daily inspection reports, as well as all other pertinent observations and information. The logbook shall be hard or spiral bound with consecutively numbered pages. Prior to final payment, submit original Inspection Logbook to the Contracting Officer upon completion of project.

3.11.2.3 Inspection Equipment

All equipment shall be in good condition, operational within its design range, and calibrated as required by the specified standard for use with each device.

3.11.3 Adhesion Testing

Not less than forty-eight hours following the second topcoat application, a minimum of three adhesion tests in accordance with ASTM-D-4541 shall be performed on the thin film flooring system. Three random flooring locations shall be selected and spaced a minimum of 20 feet between each location. Prior to attaching pull-off coupons, flooring surface shall be lightly sanded per test area and pull-off coupons shall contain a grit-blasted anchor profile. When pull-off coupon adhesive has sufficiently cured, score circumference per pull-off coupon to concrete substrate. Test adhesion and evaluate results. If testing produces cohesive failures within the concrete, concrete removal over 95 % of each pull-off coupon, and/or adhesion more than 400 psi, coating system's adhesion is acceptable. If the above requirements are not satisfied, then one adhesion test per 100 square feet shall be performed using the above procedures. Each non-compliant area shall require two additional tests to confirm results. All areas unable to meet adhesion requirements shall be removed to sound material and reworked by contractor at contractor's expense. Each area tested shall be repaired

using a combination of primer, sand-filled epoxy mortar (for deep cohesive failures, if applicable), and two urethane topcoats. Resulting repairs shall be flush with adjacent coatings and display an equivalent appearance.

3.12 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

TABLE I
MATERIAL REQUIREMENTS

Table Ia - Sealant

Test	Minimum Requirement (maximum where indicated)
Sealant System (two-pack: self-leveling)	Polysulfide (Manganese Cure; MnO ₂) or Urethane
Percent Volume Solids	100 %
Chemical Resistance to JP-8+100 Fuel @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) weight increase, 5.0 % (maximum) volume increase, 2.0 % (maximum) weight loss
Chemical Resistance to Motor Oils @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) weight increase, 5.0 % (maximum) volume increase, 2.0 % (maximum) weight loss
Chemical Resistance to Skydrols @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) weight increase, 5.0 % (maximum) volume increase, 2.0 % (maximum) weight loss
Hardness (ASTM-D-2240: Shore A)	20
Tensile Strength (ASTM-D-412), (or ASTM-D-638)	150 psi
Percent Elongation (ASTM-D-412), (or ASTM-D-638)	500 %
Tack Free @ 65°F (ASTM-C-679)	12 hours maximum
Adhesion to Concrete	140 psi
Adhesion of Urethane Topcoats (paintable sealant)	140 psi

NOTES:

- (1) A 2" x 1/2" x 1/2" section of cured sealant shall be immersed and tested:
three samples minimum.

TABLE I
MATERIAL REQUIREMENTS

Table Ib - Thin Film Flooring System

Test	Minimum Requirement (maximum where indicated)
Tensile Strength (ASTM-D-638)	700 psi
Percent Elongation (ASTM-D-638)	5.0 %
Adhesion to Concrete (ASTM-D-4541)	400 psi or 100 % failure in concrete
Thermal Compatibility between Concrete "Pass" (ASTM-C-884)	
Heat Resistance (continuous exposure)	140°F
Chemical Resistance to JP-8+100 Fuel @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) increase in weight, 2.0 % (maximum) increase in thickness, 2.0 % (maximum) loss in weight
Chemical Resistance to Motor Oils @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) increase in weight, 2.0 % (maximum) increase in thickness, 2.0 % (maximum) loss in weight
Chemical Resistance to Skydrols @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) increase in weight, 2.0 % (maximum) increase in thickness, 2.0 % (maximum) loss in weight
Lead (ASTM-D-3335)	0.06 % (maximum)
Cadmium (ASTM-D-3335)	0.06 % (maximum)
Chromium (ASTM-D-3718)	0.00 % (maximum)

NOTES:

- (1) Immediately following immersion, the coating system shall not contain blisters, checks, discoloration, softening (minimum 350 psi wet adhesion: ASTM-D-4541), lifting from substrate and/or intercoats: each shall constitute as a failure.

TABLE I
MATERIAL REQUIREMENTS

Table Ic - Primer

Test	Minimum Requirement (maximum where indicated)
Resin System (ASTM-D-2621)	Epoxy (two-pack)
Percent Volume Solids (ASTM-D-2697)	85 %
Color	17925 (white), or 17875 (ultra-light gray)
Hydrolytic Stability (See Note 1)	No effect: 30 days immersion in Sodium Hydroxide solution with pH no less than 13.5
Moisture Insensitivity Throughout Service (ASTM-F-1869, ASTM-D-4541) (See Note 2)	No effect: Insensitive to moisture vapor emission at rates no more than 3.5 lbs moisture/(1000 ft ² , 24 hrs)
Adhesion to Concrete Throughout Service (ASTM-D-4541) (See Note 3)	400 psi or 100 % failure in concrete

NOTES:

- (1) Immediately following immersion, primer shall be evaluated for blisters, checks, discoloration, softening, and substrate lifting. Primer shall visually appear free of blisters, checks, and moderate discoloration, and display wet adhesion no less than 350 psi (ASTM-D-4541).
- (2) During and following application, primer shall remain unaffected by Moisture Vapor Emission (MVE) at rates no more than 3.5 pounds moisture/1000 square feet, 24 hours: primer shall meet the requirements of Note (3). Signs of moisture sensitivity include blisters, softening, lifting, and discoloration (whitening).
- (3) When tested for in-situ adhesion, primer shall display 400 psi adhesion and/or remove no less than 35 mils of concrete over 95 % of each pull-off coupon.

TABLE I
MATERIAL REQUIREMENTS

Table Id- Urethane Topcoat

Test	Minimum Requirement (maximum where indicated)
Resin System (ASTM-D-2621)	Aliphatic Urethane (two-pack)
Percent Volume Solids (ASTM-D-2697)	52 %
Topcoat Color (Fed. Std. 595B)	17925 (white), or 17875 (ultra-light gray)
Walkway Strip Color: Red/Orange, Semi-gloss (Fed. Std. 595B)	22197 (red/orange)
Application Thickness Per Coat	≤ 3.5 mils Dry Film Thickness (DFT)
Hiding Power: Red/Orange	Complete hiding of white coatings at 2.5 -3.0 mils DFT (one coat)
Sunlight Resistance	Non-yellowing
Heat Resistance (continuous exposure)	140°F
Heat Resistance (intermittent exposure)	200°F
Chemical Resistance to JP-8 +100 Fuel @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 1.0 % (maximum) weight increase, 1.0 % (maximum) thickness increase, 1.0 % (maximum) weight loss
Chemical Resistance to Motor Oils @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 1.0 % (maximum) weight increase, 1.0 % (maximum) thickness increase, 1.0 % (maximum) weight loss
Chemical Resistance to Skydrols @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 1.0 % (maximum) weight increase, 1.0 % (maximum) thickness increase, 1.0 % (maximum) weight loss

NOTES:

- (1) Immediately following immersion, in addition to the listed requirements, urethane topcoat shall be evaluated for blisters, checks, discoloration, softening, and lifting. Urethane topcoat shall visually appear free of blisters, checks, and discoloration, and display adhesion no less than 350 psi (ASTM-D-4541).

TABLE II
PREAPPROVED MATERIALS*

<u>VENDORS</u>	<u>MATERIALS</u>	
Polyspec (281) 397 - 0033	Primer: Topcoat: Sealant:	300EX Tuffrez 235 T-2235SL
Tennant (800) 553 - 8033	Primer: Topcoat: Sealant:	Eco-MPE** VOC-CRU N/A***
Stonhard (856) 779 - 7500	Primer: Topcoat: Sealant:	Standard Primer Stonseal GS6 Vulkem 245
Crawford Labs (800) 356 - 7625	Primer: Topcoat: Sealant:	Florock 4700 Florock Super CRU N/A***
General Polymers (800) 543 - 7694	Primer: Topcoat: Sealant:	#3578, Universal Primer #4618, Polyurethane Enamel Cor-Seal PS

NOTES:

*Other products may meet specification requirements. Up to specification's date of issue, preapproved materials met specification requirements. It is the users' responsibility to confirm preapproved material formulations have not changed and specification requirements will be met. **ECO-CRE primer is to be used on floors with heavy skydrol use. ***Polyspec T-2235SL sealant may be used.

APPENDIX A

INSTRUCTIONS FOR MODIFYING SECTION 01450 TO ADD NACE INSPECTOR

Modify Section 01450 to include NACE Coating Inspector as follows:

1. In the Article entitled "SUBMITTALS," add submittal requirement "SD-07 Certificates," add "NACE Coating Inspector; G," and add the following paragraph below the addition of "NACE Coating Inspector; G."

Submit documentation confirming each coating inspector is classified no less than "Intermediate" Coating Inspector under the National Association of Corrosion Engineers (NACE) Coating Inspector Program (NACE CIP) and has successfully completed, as a minimum, "Session III" of NACE CIP. Include NACE Coating Inspector identification number, date of qualification, expiration date, and copy of "Session III" certificate or copy of "NACE Certified" certificate. The NACE Coating Inspector shall work directly for the prime construction contractor and work as part of the prime's Quality Control (QC) Organization. Each NACE Coating Inspector with prior and/or current business relations to job site subcontractors, material suppliers, and equipment suppliers, shall automatically be disqualified. Submit documentation confirming NACE Coating Inspectors have met the aforementioned requirements over the past two years.

2. Add the following table to the Article entitled "QC Specialists Duties and Qualification:"

<u>Qualification/Experience in Area of Responsibility</u>	<u>Area of Responsibility</u>	<u>Frequency</u>
NACE Coating Inspector	Surface preparation, flooring system installation, field tests, and field inspection.	Full time during surface preparation, flooring system installation, field tests, and field inspection.

3. Use NACE Coating Inspector on all flooring projects or, as a minimum, on flooring projects with greater than 3,000 square feet.



APPENDIX B

NFGS-09612

**“EPOXY MORTAR FLOORING SYSTEM FOR
AIRCRAFT MAINTENANCE FACILITIES”**

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
GUIDE SPECIFICATION

NFGS-09612
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SECTION 09612

EPOXY MORTAR FLOORING SYSTEM
FOR AIRCRAFT MAINTENANCE FACILITIES

09/00

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- Ib: Epoxy Mortar Flooring System
- Ic: Primer
- Id: Grout Coat
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TABLE II PREAPPROVED MATERIALS

APPENDIX A INSTRUCTIONS FOR MODIFYING SECTION 01450 TO ADD NACE INSPECTOR

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EPOXY MORTAR FLOORING SYSTEM
FOR AIRCRAFT MAINTENANCE FACILITIES

Preparing Activity: NFESC

Type Name & Reg.	Signature	Date
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DEPARTMENT OF THE NAVY
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SECTION 09612

EPOXY MORTAR FLOORING SYSTEM
FOR AIRCRAFT MAINTENANCE FACILITIES

9/00

NOTE: This guide specification covers the requirements for a five-coat, epoxy mortar flooring system with reflective urethane topcoats, slip resistance, and joint work. The epoxy mortar flooring system is appropriate for use on: aircraft maintenance hangars, equipment maintenance shops, jet engine test cells, and all other industrial floors where resistance to impact, abrasion, and fuel is required. Installation costs: \$5.00 - \$10.00 square foot. Nominal thickness: 1/4 inch. Benefits: Tolerates high rates of Moisture Vapor Emission (MVE), produces a level surface over coarse concrete, high impact resistance, good chemical resistance, and may provide a suitable topcoat base for more than 10 years service. Can be rejuvenated by replacing urethane topcoats, and non-skid, only. Approximate service life: Urethane topcoating with non-skid grit at three or more years. The flooring system is neither conductive nor Electro-Static Dissipative (ESD), however, either formulation is easily designed upon request. This specification is not for use in overcoating existing sound coating systems.

NOTE: Prior to the flooring system's installation, a concrete condition assessment in accordance with the Naval Facilities Engineering Service Center's (NFESC) Users Guide (UG)-2036-SHR is highly recommended. The condition assessment is designed to identify problem floors and eliminate premature flooring failures produced by: 1) Coating concrete with low surface strength, 2) Coating concrete with high levels of surface contamination (oils, fuels, fats, waxes, etc.), and 3) Coating concrete with a high rate of Moisture Vapor Emission (MVE). The epoxy mortar flooring system is suitable for application to: A) Either "Smooth" or "Coarse" concrete surface textures, B) Concrete with a rate of MVE no more than 4.5 pounds moisture/24 hours, 1000 square feet (ASTM-F-1869), C) Concrete with surface strength greater

than 200 psi (ASTM-D-4541), and D) Concrete with fuel/oil contamination to a depth no more than 1/4 inch.

NOTE: If a concrete floor has a rate of Moisture Vapor Emission (MVE) more than 4.5 pounds moisture/24 hours, 1000 square feet (ASTM-F-1869), a layered Moisture Reducing System (MRS) shall be applied prior to the application of the epoxy mortar flooring system. The MRS shall be compatible with the submitted flooring system and approved/warranted by the manufacturer of the epoxy mortar flooring system. The MRS shall be applied to shot blasted concrete and reduce the rate of MVE to less than 4.5 pounds moisture/24 hours, 1000 square feet. MRSs can employ combinations of concrete sealers, specific epoxies, and moisture insensitive grouts, with or without mesh. MRSs are available from the following partial list of epoxy mortar flooring system vendors: Tennant (800) 553 - 8033, Stonhard (856) 779 - 7500, General Polymers (800) 543 - 7694. Moisture Vapor Emission Test Kits (MVETK) are available from the following partial list of vendors: Floor Seal (800) 295 - 0221, Sinak (619) 231 - 1771, General Polymers (800) 543 - 7694.

NOTES: Include Section 03930 "Concrete Rehabilitation" for repair of minor spalls and surface deterioration to depths less than three inches. Specify epoxy mortar for repairs to depths no more than two inches. Specify epoxy concrete for repairs to depths from one to three inches. Repairs to depths greater than one inch shall contain a rectangular geometry with saw cut edges. Repairs shall be finished to resemble surrounding concrete using a stainless steel trowel.

Include Section 02983 "Partial Depth Patching of Rigid Pavements" for repair of large spalls and severe deterioration to depths from three to six inches. Specify Portland Cement Concrete (PCC) with less than 0.45 water-cement ratio, light steel trowel finish, and cure using plastic coated burlap. Geometry for repairs shall be rectangular with saw cut edges to a nominal repair depth of six inches. PCC repair shall cure for approximately 30 days prior to the application of the flooring system. Do not cure repairs using liquid membrane-forming compounds.

For repair of spalls and severely distressed concrete to depths greater than six inches, seek material guidance from Section 03300 "Cast-In-Place Concrete" and procedural guidance from the American Concrete Pavement Association (ACPA) Guideline TB-002.02P

"Concrete Paving Technology - Guidelines for Full-Depth Repair." Repair base shall contain a minimum of two inches of clean, non-reactive concrete sand over a suitable vapor retarder (0.25 mm 10 mils polyethylene sheeting). Repairs shall be finished by light steel trowel and cured using plastic coated burlap. Repairs shall cure for approximately 30 days, or more, prior to the application of the flooring system. Do not cure repairs using liquid membrane-forming compounds.

Curled and/or settled slab ends with joint surfaces displaying more than 1/8 inch difference in vertical height shall be scarified level. Resulting surfaces shall contain a height difference no more than 1/16 inch and a surface texture equal ICRI-CSP 4.

NOTE: Include Section 03300 "Cast-In-Place Concrete" for new concrete slab construction. Measures shall be employed to control the rate of base, subbase, and subgrade Moisture Vapor Emission (MVE) to total no more than 3.0 pounds moisture/24 hours, 1000 square feet when measured on the slab's surface (ASTM-F-1869). Improper MVE controls have produced numerous premature coating failures. In addition to appropriate subbase drainage, specify a minimum of two inches of clean, non-reactive concrete sand over no less than 0.25 mm 10 mils of polyethylene sheeting (ASTM-D-4397) with sealed lap joints. Specify concrete mix to be free of both accelerators containing calcium chloride and other sources of chloride ion contamination. Specify two passes of a light power troweled finish and cure using plastic coated burlap or equal method. Do not cure concrete using liquid membrane-forming compounds. Do not specify surface hardeners or dry shake finish (NFGS-09965). Approximately 60 days following the concrete pour and prior to the installation of the flooring system, test concrete for rate of MVE and confirm rate is no more than 4.5 pounds moisture/24 hours, 1000 square feet (ASTM-F-1869). Consult ACI 224.3R "Joints in Concrete Construction," ACI 302.1R "Guide for Concrete Floor and Slab Construction," ACI 360R "Design of Slabs on Grade," and other appropriate construction guidance.

NOTE: Where tile is to be removed prior to the application of flooring system, test both tile and mastic for the presence of asbestos. If asbestos is detected, include NFGS-S-13281 "Engineering Control of Asbestos Containing Materials" for removal and disposal.

NOTE: If flooring system is to be applied to warehouse floors with heavy fork lift traffic, a semi-flexible joint sealant is required in lieu of the specified flexible sealant. Use a semi-flexible epoxy sealant with approximately 90 % elongation. Semi-flexible sealants shall not be used in areas exposed to exterior temperatures.

NOTE: Include Section 01450 "Quality Control."

NOTE: Include Section 01575 "Temporary Environmental Controls." This Section defines fugitive dust, generated waste, hazardous materials, hazardous substance, hazardous waste, solid waste, construction and demolition (CD) debris, and liquid waste, and contains documentation for dangerous waste profiles, waste information sheet, waste identification document, waste generation record, landfill disposal form, and hazardous material reporting.

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. Within the specification, publications are referred to by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 307	(1999) Standard Test Method for Tensile Strength of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings
ASTM C 531	(2000) Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concrete
ASTM C 579	(1996) Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C 679	(1997) Standard Test Method for Tack-Free Time of Elastomeric Sealants
ASTM C 884	(1998) Standard Test Method for Thermal Compatibility between Concrete and Epoxy-Resin Overlay

ASTM D 412	(1998) Standard Test Method for Vulcanized Rubber and Thermoplastic Rubber and Thermoplastic Elastomers - Tension
ASTM D 638	(1999) Standard Test Method for Tensile Properties of Plastics
ASTM D 1308	(1998) Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 2240	(1997) Standard Test Method for Rubber Property-Durometer Hardness
ASTM D 2621	(1995) Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
ASTM D 2697	(1998) Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D 3335	(1999) Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D 3718	(1999) Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
ASTM D 3925	(1996) Standard Practice for Sampling Liquid Paints and Related Pigmented Coatings
ASTM D 4541	(1995) Standard Test Method for the Pull-off Strength of Coatings Using Portable Adhesion Testers
ASTM D 6237	(1998) Standard Guide for Painting Inspectors (Concrete and Masonry Substrates)
ASTM E 11	(1995) Standard Specification for Wire Cloth and Sieves for Testing Purposes
ASTM F 1869	(1998) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1000	Air Contaminants
29 CFR 1926.59	Hazard Communication

FEDERAL SPECIFICATIONS (FS)

FED-STD-595

(Rev. B) Colors Used in Government
Procurement

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI-03732

Technical Guideline: "Selecting and
Specifying Concrete Surface Preparation for
Sealers, Coatings, and Polymer Overlays

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-TU 2

(1997) Design, Installation, and Maintenance
of Coating Systems for Concrete Used in
Secondary Containment

1.2 SUBMITTALS

NOTE: Where a "G" in submittal tags follows a
submittal item, it indicates Government approval for
that item. Add "G" in submittal tags following any
added or existing submittal items deemed sufficiently
critical, complex, or aesthetically significantly to
merit approval by the Government. Submittal items
not designated with a "G" will be approved by the QC
organization.

Submit the following in accordance with Section 01330, "Submittal
Procedures."

SD-04 Samples

Joint Sealant; G

Epoxy Mortar Flooring System; G

White Aluminum Oxide Non-Skid Grit; G

SD-06 Test Reports

Joint Sealant; G

Epoxy Mortar Flooring System; G

Primer; G

Grout Coat; G

Urethane Topcoat; G

White Aluminum Oxide Non-Skid Grit; G

Patch Test Demonstration; G

Daily Inspection Report; G

Adhesion Testing; G

SD-07 Certificates

Work plan; G

Flooring System Applicator Qualifications; G

Joint Sealant; G

Epoxy Mortar Flooring System; G

Warranty; G

SD-08 Manufacturer's Instructions

Joint Sealant; G

Epoxy Mortar Flooring System; G

Water-Based Alkaline Degrease; G

SD-11 Closeout Submittals

Inspection Logbook; G

1.3 QUALITY ASSURANCE

1.3.1 Test Reports

1.3.1.1 Joint Sealant

Submit test results that confirm sealant complies with the requirements of Table 1a. Samples must have been tested within the last three years.

1.3.1.2 Epoxy Mortar Flooring System

Submit test results that confirm epoxy mortar flooring system complies with the requirements of Table 1b. Samples must have been tested within the last three years.

1.3.1.3 Primer

Submit test results that confirm primer complies with the requirements of Table 1c. Samples must have been tested within the last three years.

1.3.1.4 Grout Coat

Submit test results that confirm grout coat complies with the requirements of Table 1d. Samples must have been tested within the last three years.

1.3.1.5 Urethane Topcoat

Submit test results that confirm urethane topcoat complies with the requirements of Table 1e. Samples must have been tested within the last three years.

1.3.1.6 Daily Inspection Report

Submit one copy of the daily inspection report to the Contracting Officer within 24 hours of the date recorded.

1.3.2 Certificates

1.3.2.1 Work Plan

Submit schedule to complete work within approximately twelve (12) consecutive calendar days. Submit a written plan describing in detail all phases of coating operations. Address work sequencing, surface preparation, flooring system application, recoat and cure time projections, as well as how each step will be controlled, tested, and evaluated. Address safety measures, work scheduling around weather, and record keeping. Contractor shall assign one supervisor to the job who is to remain on site throughout all phases of work, and who is to act as the contractor's primary point of contact. This person shall be identified in the submitted schedule.

1.3.2.2 Flooring System Applicator Qualifications

Minimum requirements for the installation contractor are as follows: Installation contractor shall have completed three or more jobs within the past two years applying the specified materials to concrete surfaces in which the total area exceeds 200,000 square feet. Contractor shall submit documentation listing location of work, point of contact at job site, total square footage of applied materials, listing of both materials and equipment used, and validation from coating manufacturer documenting quantity of materials purchased per job for work totaling 200,000 square feet within the past two-years. In addition to the above requirements, installation contractor shall be certified by the material manufacturer(s) to install the submitted coatings and sealant. Submit copy of certificates.

1.3.2.3 Joint Sealant

Submit literature documenting the past performance of the sealant's use in automotive and/or aircraft maintenance shops. Minimum requirements are two or more maintenance shops with joint work totaling 10,000 linear feet whereby the sealant has performed for two years with less than 1 % combined sealant failures and defects. Sealant manufacturer shall list location of shops, total linear feet of sealant applied per shop, shop point of contact, date sealant was applied, and the name of the installed sealant material.

1.3.2.4 Epoxy Mortar Flooring System

Submit literature documenting the past performance of the epoxy mortar flooring system's use in aircraft maintenance shops and over floors with high rates of Moisture Vapor Emission (MVE). Minimum requirements are two or more aircraft maintenance shops totaling 34,000 square feet whereby the flooring system has performed for two years with less than 0.05 % combined premature coating failures, material defects and surface discoloration: no more than 0.03 % discoloration from aviation chemicals, tire plasticizers, and UV exposure. Provide a minimum of two additional case histories where successful installation occurred on floor slabs with no less than 4.5 lbs moisture/24 hours, 1000 square feet. Flooring manufacturer shall list location of shops, total coated area per shop, shop point of contact, date coating system was applied, successful installation to concrete with high MVE, and the names of the installed coating materials.

1.3.2.5 Warranty

For a minimum period of one-year following flooring and sealant application, "Installation Contractor" shall warrant materials and workmanship. The following terms and conditions form a part of the warranty. If the applied flooring system develops either blisters (chemical), checks, softening, or lifting within one-year following application, each area shall be reworked by installation contractor at contractor's expense. The following conditions are excluded from the warranty: A) Reflective concrete cracking, flooring system mirrors cracks in concrete, B) Cosmetic imperfections due to scratching and gouging, C) Application to metallic concrete finishes (NFCS-09965), and D) Application to concrete with a rate of Moisture Vapor Emission (MVE) > 5.0 pounds moisture/24 hours, 1000 square feet. If the flooring system's adhesion is in question, one adhesion test shall be performed per 100 square feet as described in the Article entitled "ADHESION TESTING." To satisfy the warranty, adhesion testing shall produce cohesive failures within the concrete, concrete removal over 95 % of each pull-off coupon, and/or adhesion no less than 400 psi. Each area failing to meet adhesion requirements shall require two additional adhesion tests to confirm results. Within the warranty period, all areas unable to meet adhesion requirements shall be removed to sound material and reworked. There shall be 0 % sealant failures within one year. Within the warranty period, all sealant material with chemically attacked surfaces and/or lifting from joint walls shall be removed and reworked. Topcoat cracking over sealant is excluded from warranty.

1.3.3 Product Data

1.3.3.1 Joint Sealant

Submit manufacturer's printed instructions to include detailed application procedures, minimum and maximum application temperatures, and curing procedures. In accordance with 29 CFR 1926.59, include Materials Safety Data Sheets (MSDS) for the sealant to be used at the job site

1.3.3.2 Epoxy Mortar Flooring System

Submit manufacturer's printed instructions to include detailed mixing, minimum and maximum application temperatures, acceptable atmospheric and/or interior climatic conditions, application procedures, curing procedures, and procedures for maintenance cleaning of flooring system. Provide explicit instructions detailing surface preparation, recoat windows and remedial actions in case recoat windows are missed, and, if applicable, solvent-wiping between coats with acceptable types and grades of solvents. In accordance with 29 CFR 1926.59, include MSDSs for the flooring system to be used at the job site.

1.3.3.3 Water-Based Alkaline Degreaser

Submit manufacturer's printed instructions to include detailed mixing, rate of dilution, application procedures, and rinsing procedures. In accordance with 29 CFR 1926.59, include MSDSs for the water-based alkaline degreaser to be used at the job site.

1.4 DELIVERY, STORAGE, AND HANDLING

Coatings and sealant shall be stored in spaces with temperatures from 40 to 75 degrees F. Materials on site shall be inspected for damage prior to use. Packaged materials in dented, rusty, or leaking containers shall be returned

to manufacturer. Materials with an expired shelf life shall be returned to manufacturer, tested, and if compliant, re-issued a shelf life extension.

1.5 COATING HAZARDS

NOTE: Include either Section 01525 "SAFETY REQUIREMENTS" or prepare instructions detailing each element of safety for use with this section.

Ensure that employees are trained in all aspects of the safety plan. The coating manufacturer's written safety precautions shall be followed throughout mixing, application, and curing of coatings. Comply with respiratory protection requirements in 29 CFR 1910.134 and safe levels of airborne contaminants in 29 CFR 1910.1000.

1.6 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM-D-4541, ASTM-D-6237, SSPC-TU 2, and ICRI-03732, including replica standards ICRI-CSP 1 through ICRI-CSP 9, at the job site.

1.7 PATCH TEST DEMONSTRATION

NOTE: This is a very important part of the submittal process. While it is unusual to require a test patch prior to approval of the submitted materials, this floor system is unusual in that it is required to perform some significant tasks for a long time. Proof of contractor claims, especially under conditions to be encountered in the specific project, is considered necessary.

If customer dislikes level of non-skid grit, adjustments to the specification can be made. Grit coarser than #60 aluminum oxide is not recommended. On architectural floors, non-skid grit broadcast rates can range from none to approximately half the specified level.

Prior to the submitted flooring system's approval, the installation contractor shall apply the complete flooring system to a ten-foot by ten-foot square section of concrete as prepared in accordance with Part 3 "EXECUTION." Within this area, three adhesion tests shall be performed as described in the Article entitled "ADHESION TESTING." If concrete surface preparation was insufficient, contractor shall apply an additional coating system patch to properly prepared concrete followed by the above adhesion testing. If adhesion results are unacceptable for both the topcoat and the coatings below the grout coat, contractor shall submit a new flooring system manufactured by a different coating vendor. A patch of the new flooring system shall be applied and subjected to the above requirements for adhesion prior to approval. If customer dislikes non-skid grit application, adjustments to the specification may be made. Grit coarser than #60 aluminum oxide is not recommended. Immediately following adhesion testing, the test patch shall be removed and sanded flush with surrounding concrete.

PART 2 PRODUCTS

NOTE: The specified materials are not appropriate for use in primary chemical containment, secondary chemical containment, or on floors subjected to spills from concentrated acids, bases, and organic solvents. Consult with the Naval Facilities Engineering Service Center's (NFESC) Paints and Coatings Center of Expertise for alternative coating systems to suit specific Navy needs.

2.1 JOINT SEALANT

The joint sealant shall be formulated to exhibit the properties as listed in Table Ia.

2.2 EPOXY MORTAR FLOORING SYSTEM

A five-coat flooring system consisting of primer, epoxy mortar, grout coat, and two urethane topcoats. The system shall be applied at a nominal thickness of 1/4 inch and contain broadcasts of aluminum oxide nonskid grit. The complete flooring system shall be formulated to exhibit the properties as listed in Table Ib. Additional requirements for primer coat, grout coat, and urethane topcoat are listed below.

2.2.1 Primer Coat

In addition to the requirements of the epoxy mortar flooring system, the primer coat shall be formulated to exhibit the properties as listed in Table Ic.

2.2.2 Grout Coat

In addition to the requirements of the epoxy mortar flooring system, the grout coat shall be formulated to exhibit the properties as listed in Table Id.

2.2.3 Urethane Topcoat

In addition to the requirements of the epoxy mortar flooring system, the urethane topcoat shall be formulated to exhibit the properties as listed in Table Ie.

2.3 WHITE ALUMINUM OXIDE NON-SKID GRIT

Size #60, dust-free (washed and dry), minimum 99% pure, having the following sieve analysis (ASTM-E-11):

Sieve No. 40	100 % passing
Sieve No. 50	15 - 30 % retained
Sieve No. 60	70 - 85 % retained
Sieve No. 70	0 - 15 % retained

PART 3 EXECUTION

3.1 COATING SAMPLE COLLECTION

The Contracting Officer and QC Manager shall witness all material sampling. The Contracting Officer shall be notified a minimum of three days in advance of sampling. Obtain liquid samples of each coating component (e.g., primer, intermediate, grout coat, topcoat) by random selection from sealed containers and in accordance with ASTM-D-3925. Samples shall be either individual cans of liquid material or one-pint quantities of properly mixed, extracted, and sealed liquid material. Label samples by designated name, specification number, batch number, project contract number, sample date, intended use, and quantity involved. When the applied coating system has met the requirements defined in the Article entitled "ADHESION TESTING," coating samples shall be returned to the installation contractor for proper disposal.

3.2 TILE AND TILE ADHESIVE REMOVAL

NOTE: Delete "Tile and Tile Adhesive Removal" if
concrete is not tiled.

Remove 100 % of tile employing a combination of one or more of the following techniques: chipping, scraping, sanding, scarification, high-pressure water, and various hand tools. Remove 100 % of tile adhesive using solvents and power scrubbing. Remove residual contamination using hot potable water under a minimum of 4,000 psi pressure. Resulting surfaces shall appear visually clean and display the gray color of concrete.

3.3 JOINT MATERIAL REMOVAL, RE-SAW CUTTING, CRACK CHASING

Remove 100 % of the existing material in all joints including material bonded to joint walls and base. Rigid material may require the use of saw cutting equipment to remove. Joints may be widened by up to 1/8 inch when re-saw cutting. Concrete cracks identified for repair shall be chased and opened to a minimum depth of 1/2 inch below crack surface. Resulting chased crack(s) shall contain smooth vertical walls.

3.4 DEGREASING

On both previously coated and uncoated concrete, degrease entire floor by scrubbing using a solution of hot potable water, 120°F - 170°F, and a concentrated water-based alkaline degreaser. Two complete degreasing cycles shall be performed on entire floor surface. Allow solution to soak into surfaces prior to scrubbing and remove using hot potable water under a minimum of 4,000 psi pressure. Rinsing shall be complete when the rinse water appears clear. If the industrial detergent is not biodegradable, all rinse water shall be collected and disposed of as hazardous waste. Squeegees and shop vacuums may be used to collect pooling rinse water. Fans may be used to aid drying of floor surfaces.

3.5 COATING SYSTEM REMOVAL

NOTE: Delete "Coating System Removal" if concrete is
uncoated.

Remove 100 % of the existing coating system employing a combination of one or more of the following techniques: shot blasting, chipping, scraping, sanding, scarification, high pressure water blasting, and various hand tools. The use of impact tools such as scabblers may be used to remove unsound epoxy mortar flooring systems. In general, a coating system can not be completely removed by shot blasting and, to attain 100 % coating removal, requires combinations of one or more of the above techniques.

3.6 SURFACE PREPARATION

Shot blast entire floor to produce a level of coarseness equal to ICRI-CSP 3. Each pass of shot blasting shall be slightly overlapped by 1/4 inch to 1/2 inch. New shot shall be added to shot blasting equipment prior to blasting. Concrete surfaces inaccessible to shot blasting, base of perimeter walls and under secured equipment, shall be prepared using diamond disk grinding and/or light scarification to produce a level of coarseness equal to ICRI-CSP 2, ICRI-CSP 4, respectively. Resulting surfaces shall appear visually clean and contain the appropriate level of surface coarseness. If the resulting level of cleanliness can not be determined, place numerous drops of water on surfaces that appear visually contaminated. If the water drops soak into concrete, surfaces are free of hydrocarbon contamination (oils, grease, skydrol). If the water drops bead up and do not flatten out, surfaces require additional degreasing as detailed in the Article entitled "DEGREASING." Shot blasting coarse concrete and/or broom finished concrete can produce a level of coarseness equal to ICRI-CSP 5: a best effort attempt shall be employed to minimize over shot blasting coarse concrete. If coarse concrete is encountered, shot blasting to a level of coarseness equal to ICRI-CSP 5 is acceptable: however, extremely coarse concrete can require resurfacing prior to the flooring system's installation. Sweep, vacuum, and run a high powered magnet over all surfaces to be coated.

3.6.1 CMU Surface Preparation

NOTE: Delete paragraph if epoxy mortar is not to be applied to the base of CMU walls.

A minimum of four inches up the base of CMU walls adjacent flooring space, remove 100 % of coatings and prepare surface by power grinding to a resulting level of coarseness equal to ICRI-CSP 2. If oils/grease are present, degrease in accordance with the Article entitled "DEGREASING."

3.7 COVE STRIP INSTALLATION

NOTE: Delete paragraph if epoxy mortar is not to be applied to the base of CMU walls.

Install a continuous cove strip at a nominal height of four inches up the base of each CMU perimeter wall. The cove strip shall be solvent resistant and installed using a solvent resistant adhesive.

3.8 KEY-IN TERMINATIONS

NOTE: If the epoxy mortar flooring system is to be applied up the base of CMU walls, a Key-In termination is not required adjacent these walls.

The "Key-In" termination as detailed in Figure 8 of SSPC-TU 2 shall be placed at transition surfaces, directly below doorways, and adjacent walls, floor drains, drain grates (interior side), and all other obstructions embedded into the floor slab. The Key-In termination shall contain one vertical wall at a depth from 3/8 inch to 5/8 inch and, leading down to the resulting vertical depth, a sloped surface from 1.5 inches to 2 inches. A hand held concrete saw can be used to cut the correct vertical depth followed by power tool grinding to create a sloped surface. Remove concrete dust by vacuuming.

3.9 CRACK REPAIRS

The "Elastomeric Underlayer Crack-Bridging Design" as detailed in Figure 7 of SSPC-TU 2 shall be used over the surface of epoxy mortar filled cracks.

3.9.1 Install Bondbreaker

Install bondbreaker, either solvent resistant bondbreaker tape or a 1/8 inch to 1/4 inch layer of #20 - #40 mesh silica sand, to the base of previously chased cracks identified for repair. For cracks without a rigid base, install suitably sized fiberboard to a depth 1/2 inch below floor level and with bondbreaker over exposed fiberboard. The installed bondbreaker shall cover the crack's horizontal base and continuously span the entire crack length. Application of bondbreaker prevents epoxy mortar from penetrating deep into cracks. Bondbreaker tape shall contain a thickness no more than 6 mils. In this application, the use of backer rod is prohibited.

3.9.2 Repair Cracks

Using the specified materials, prime interior crack walls and apply epoxy mortar directly into wet primer. Finish epoxy mortar level with floor and without feathered edges. When cured, remove mortar imperfections by sanding flush with adjacent concrete. Apply solvent resistant tape parallel to each side of the mortar filled crack(s) at a minimum inner width of four inches between tape. A four inch inner tape width is generally suitable for cracks less than 1/2 inch wide whereas cracks more than 1/2 inch wide can require an inner tape width of six inches. Apply 40 ± 5 mils of the specified sealant, in one coat, directly over filled crack(s) and spread flush with inner tape edges: a stiff bristled paintbrush can be used to spread the sealant. Use a Wet Film Thickness (WFT) gauge to confirm sealant application is between 35 to 45 mils wet. Remove tape and allow sealant to cure a minimum of 24 hours prior to the application of the epoxy mortar flooring system. Sealant application above 50 mils dry will require removal and reapplication by contractor at contractor's expense.

3.10 PRE-APPLICATION TESTING FOR CONTAMINATION

Spot check surfaces for oil/grease contamination using the water break test. At a rate of 5 tests per 1000 square feet, place one to two drops of water onto surfaces and observe for beading. Test all other surfaces that show

visible signs of potential contamination. Surfaces displaying water beading shall receive additional degreasing in accordance with the Article entitled "DEGREASING."

NOTE: At this point in the installation sequence, minor spalls and surface deterioration to depths less than three inches can be repaired. Use epoxy mortar for repairs to depths no more than two inches. Use epoxy concrete for repairs to depths from one to three inches. Repairs to depths greater than one inch shall contain a rectangular geometry with saw cut edges. Repairs shall be finished to resemble surrounding concrete using a stainless steel trowel. Include Section 03930 "Concrete Rehabilitation" if concrete repairs of this nature are required.

3.11 COATING APPLICATION

Prior to the application of the flooring system, vacuum flooring space and mark all joints.

3.11.1 Isolation (Expansion) and Construction Joint Treatment

Install into each isolation (expansion) and construction joint a continuous length of round polyethylene backer rod flush with the floor's surface and under 30 % compression. Placement of backer rod prevents epoxy mortar from penetrating into isolation and construction joints.

3.11.2 Contraction Joint Treatment

Apply primer and epoxy mortar directly into all contraction joints. This quantity of material is in addition to the specified 1/4 inch epoxy mortar thickness. This step may be performed either prior to the full application of epoxy mortar or during.

3.11.3 Primer Application

Apply primer to flooring space at a minimum of 10.0 mils wet.

3.11.4 Epoxy Mortar Application

Apply epoxy mortar at 1/4 inch directly into wet primer using a screed box or equal equipment. Finish open areas using a power trowel with stainless steel blades. Perimeter edges and adjacent equipment footings may require finishing by stainless steel hand trowel. Directly above areas with Key-In terminations and at a distance from 1.0 inch to 1.5 inches away from the mortar's outer edge, slope the mortar down and flush with the concrete's surface. The resulting angle shall terminate flush with the vertical cut of each Key-In termination. When sufficiently cured, sand entire mortar surface. Resulting surface shall appear level, contain uniform thickness, and be free of surface imperfections including trowel marks.

3.11.5 Primer Application to CMU Walls

NOTE: Delete paragraph if epoxy mortar is not to be applied to the base of CMU walls.

When the epoxy mortar has sufficiently cured, prime approximately four inches up the base of CMU walls to cove strip and two inches adjacent the wall's base using the specified primer.

3.11.6 Epoxy Mortar Application to CMU Walls

NOTE: Delete paragraph if epoxy mortar is not to be applied to the base of CMU walls.

Apply epoxy mortar directly into wet primer at 150 to 250 mils wet. A cove trowel shall be used to create a rounded transition between floor surfaces and the base of perimeter walls. When sufficiently cured, sand the base and four inches up perimeter walls. Resulting finish shall contain a rounded transition of uniform thickness between flooring surface and CMU walls. When sufficiently cured, sand mortar surfaces. Resulting surface shall be free of surface imperfections including trowel marks.

3.11.7 Grout Coat Application

NOTE: The color of the grout coat shall be identical to the selected topcoat color, either white or ultra-light gray. Ultra-light gray is preferred to white.

Sweep and vacuum up residual dust from epoxy mortar sanding. Apply the grout coat at a minimum of 10 mils wet to the epoxy mortar and, if applicable, up the base of CMU walls. If the cured grout coat feels oily/greasy, an amine blush has occurred which requires removal. The coating manufacturer shall be consulted to recommend an appropriate blush removal procedure. Epoxy amines can blush during cool temperatures with high humidity.

3.11.8 Grout Coat Sanding

Sand grout coat using 100 grit or finer sandpaper to a dull appearance with visible scratches. Resulting surface shall appear 100 % absent of gloss with zero shiny spots. Perimeter edges and around equipment footings shall also be lightly sanded.

3.11.9 Saw Cutting and Sealing Joints

The "Conventional Sealed Joint" as detailed in Figure 1 of SSPC-TU 2 shall be used to seal each contraction and expansion joint. Care shall be taken to reduce contamination from saw cutting equipment and foot traffic. Floor access shall be limited to essential contractor personnel. When performing joint work, including saw cutting, clean rolled cardboard may be placed adjacent joint surfaces to reduce coating system contamination.

3.11.9.1 Saw Cut Contraction Joints

Place saw cuts directly in the middle of each contraction joint. Saw cuts shall be 1/4 inch wide, placed to a minimum depth of 1.25 inches, and span the joint's entire length.

3.11.9.2 Saw Cut Isolation (Expansion) and Construction Joints

Place saw cuts to the isolation (expansion) and construction joint's original width and to a minimum depth of 1.25 inches. Completely remove the epoxy mortar across the joint's width and further remove the previously installed backer rod.

3.11.9.3 Install Backer Rod

Install a continuous length of round, closed-cell polyethylene backer rod into each saw cut. For 1/2 inch, 3/8 inch, and 1/4 inch wide saw cuts, backer rod shall be placed to a depth of 3/8 inch below the surface of the grout coat: depth equals the distance from the grout coat's surface to the highest point on the backer rod. For expansion joint saw cuts greater than or equal to 3/4 inch wide, place backer to a depth of 5/8 inch below the grout coat's surface. Backer rod shall fit tight between joint walls under 30% compression and placed using a backer rod tool. All backer rod that is installed using either the incorrect size or at the incorrect depth shall be removed and reinstalled. Following backer rod installation, apply painter's tape to surfaces adjacent joints to protect from sealant.

3.11.9.4 Joint Sealant Application

Apply sealant directly into joints using a bulk-caulking gun. At room temperature, the resulting sealant application shall exhibit a concave recess between 1/8 inch to 1/32 inch below the grout coat's surface. Cured sealant remaining either flush or greater shall be removed and reapplied by contractor at contractor's expense. Following sealant application, remove painter's tape and sealant drips on grout coat. Prior to topcoating, sealant shall cure a minimum of 24 hours.

3.11.10 Application of Topcoats

Two coats of urethane topcoat shall be applied with broadcasts of #60, white, aluminum oxide non-skid grit.

3.11.10.1 Non-Skid Grit Broadcast

NOTE: Aircraft hangars servicing light aircraft with weight less than 40,000 pounds may require a higher loading of non-skid grit. Up to one additional pound per 100 square feet of the specified non-skid grit can be broadcast into the second topcoat application. The additional grit will assist in towing aircraft under wet conditions; however, the additional grit will decrease coating aesthetics.

On either warehouse or architectural floors, considerably less non-skid grit may be appropriate. Broadcast rates can range from none to less than 1.0 pound per 1000 square feet.

Broadcast non-skid grit at a rate of 1.5 pounds per 100 square feet into the first urethane topcoat and backrolled. The floor shall be mapped into 600 square foot sections where 9.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 square foot section. Broadcast non-skid grit at a rate of 1.0 pound per 100 square feet into the second urethane topcoat and backrolled. The floor shall be mapped into 600 square foot sections where 6.0 pounds of non-skid grit is pre-weighed, placed into clean buckets and used in its entirety per marked 600 square foot section.

3.11.10.2 Grout Coat Cleaning

Inspect floor for shiny grease spots and, if detected, spot degrease using manufacturer approved solvent(s) with clean, lint-free rags. Sweep and vacuum up all residual dirt and dust. Solvent wipe all surfaces using solvent(s) and procedures as recommended by manufacturer of epoxy mortar flooring system.

3.11.10.3 First Topcoat

Apply a full coat of the urethane topcoat at a spreading rate from 2.5 to 3.0 mils Dry Film Thickness (DFT). Stripe coat perimeter edges and around equipment footings. Contractor shall monitor and report a minimum of one Wet Film Thickness (WFT) reading per 600 square foot section of floor surface prior to broadcasting non-skid grit. When the correct WFT has been applied per 600 square feet of area, immediately and evenly broadcast non-skid grit into the urethane topcoat and backroll in two directions. Sealant is to be lightly coated.

3.11.10.4 Second Topcoat

Apply a second coat of the urethane topcoat at a spreading rate from 2.5 to 3.0 mils DFT. Stripe coat perimeter edges and around equipment footings. Contractor shall monitor and report a minimum of one WFT reading per 600 square foot section of floor surface prior to broadcasting non-skid grit. When the correct WFT has been applied per 600 square feet of area, immediately and evenly broadcast non-skid grit into the second topcoat of urethane and backroll in two directions. The adhesion of the epoxy mortar flooring system shall be tested in accordance with the Article entitled "ADHESION TESTING."

3.11.10.5 Walkway Stripe

NOTE: Delete paragraph if walkway stripe is not required.

Place walkway stripe according to Government drawings. When the second topcoat is within its recoat window, apply a walkway stripe of the red/orange urethane topcoat at 3.0 mils DFT. Lightly broadcast non-skid grit into the wet walkway stripe. Solvent resistant tape shall be used to protect the floor coating against stripe coat bleed. A thin clear coat of either epoxy or urethane may be required to prevent stripe coat bleed prior to the full application of the colored stripe coat. The red/orange stripe

shall completely hide, in one coat, the topcoat color. If insufficient hiding occurs, apply one additional coat of the walkway stripe.

3.12 CURING

Installed materials shall cure and display performance equal to manufacturer's product literature. Improperly cured material shall be removed and reapplied by contractor at contractor's expense.

3.13 FIELD TESTS AND INSPECTION

3.13.1 Coating Inspector

NOTE: Insert directly into Section 01450 requirement
for NACE Coating Inspector. See Appendix A for
instructions on modifying Section 01450. The NACE
Coating Inspector will act as QC Specialist.

The Coating Inspector shall be considered a QC Specialist, work for the QC Manager, and be qualified in accordance with Section 01450. The Coating Inspector will be present during all field tests, surface preparation, flooring application, initial cure of the flooring system, and during all flooring repair work. The Coating Inspector will provide all tools/equipment necessary to perform field tests and inspection. The Coating Inspector will be responsible for field tests and the specified level of inspection.

3.13.2 Inspection

The Coating Inspector shall document weather conditions, job site occurrences, and report conditions and occurrences potentially detrimental to the flooring system. The listed inspection requirements are in addition to the QC inspection and reporting requirements defined in Section 01450. The Coating Inspector shall prepare a project reference sheet outlining all requirements, tests, test methods, and evaluation criteria, and hold regular meetings with contractor personnel, including shot blasting operators and applicators, to review requirements/evaluation criteria for upcoming work prior to execution. At the start of coating operations and every 1.0 hour following until daily work is complete, record air temperature, substrate temperature, and relative humidity. Following the application of each coat, inspect surfaces for improperly cured material, blisters, inadequate and/or excessive coating thickness, and other defects. Document each inspection, test, non-compliant areas, and location of each non-compliant area. List method of evaluation, evaluation criteria, areas requiring rework, and all other pertinent observations.

3.13.2.1 Daily Inspection Report

Submit to the Contracting Officer one copy of the daily inspection report completed each day when performing work under this Section. Use Appendix X1 "Inspection Checklist" of ASTM-D-6237 to monitor daily activity and to assist in preparing the daily inspection report. Note each non-compliant issue and each issue identified for rework in accordance with the QC documentation procedures of Section 01450. Use of forms containing entry blocks for all required data is encouraged. The data shall be legible and

presented in a professional format. Submit report within 24 hours of the report date.

3.13.2.2 Inspection Logbook

The Inspection Logbook shall be a continuous record of all daily activity related to this Section. The logbook shall contain the daily inspection reports, as well as all other pertinent observations and information. The logbook shall be hard or spiral bound with consecutively numbered pages. Prior to final payment, submit original Inspection Logbook to the Contracting Officer upon completion of project.

3.13.2.3 Inspection Equipment

All equipment shall be in good condition, operational within its design range, and calibrated as required by the specified standard for use with each device.

3.13.3 Adhesion Testing

A minimum of three modified adhesion tests (ASTM-D-4541) shall be performed on the topcoat no less than forty-eight hours following application. Three random flooring locations shall be selected and spaced a minimum of 20 feet between each location. Vertically core completely through the epoxy mortar flooring system and a minimum of 3/8 inch into concrete using a suitable drill fitted with a 1 inch diameter core bit. Throughout coring, a best effort attempt shall be employed to avoid fracturing and/or overheating both the mortar system and concrete: improper coring can affect adhesion results. Adhere directly to the center of each cored surface a 3/4 inch diameter pull-off coupon. Prior to attaching pull-off coupons, flooring surface shall be lightly sanded per test area and pull-off coupons shall contain a grit-blasted anchor profile. When pull-off coupon adhesive has sufficiently cured, test adhesion and evaluate results. If testing produces cohesive failures within the concrete, concrete removal over 95 % of each pull-off coupon, and/or adhesion more than 400 psi, mortar system's adhesion is acceptable. If the above requirements are not satisfied, then one adhesion test per 100 square feet shall be performed using the above procedures. Each non-compliant area shall require two additional tests to confirm results. All areas unable to meet adhesion requirements shall be removed to sound material and reworked by contractor at contractor's expense. Core holes shall be filled using primer, sand-filled epoxy mortar, grout coat, and urethane topcoat (two applications). Resulting repairs shall be flush with adjacent coatings and display an equivalent appearance.

3.14 FINAL CLEANUP

Following completion of work, remove debris, equipment, and materials from site. Remove temporary connections to Government or contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

TABLE I
MATERIAL REQUIREMENTS

Table Ia - Sealant

Test	Minimum Requirement (maximum where indicated)
Sealant System (two-pack: self-leveling)	Polysulfide (Manganese Cure; MnO ₂) or Urethane
Percent Volume Solids	100 %
Chemical Resistance to JP-8+100 Fuel @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) weight increase, 5.0 % (maximum) volume increase, 2.0 % (maximum) weight loss
Chemical Resistance to Motor Oils @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) weight increase, 5.0 % (maximum) volume increase, 2.0 % (maximum) weight loss
Chemical Resistance to Skydrols @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 2.0 % (maximum) weight increase, 5.0 % (maximum) volume increase, 2.0 % (maximum) weight loss
Hardness (ASTM-D-2240: Shore A)	20
Tensile Strength (ASTM-D-412), (or ASTM-D-638)	150 psi
Percent Elongation (ASTM-D-412), (or ASTM-D-638)	500 %
Tack Free @ 65°F (ASTM-C-679)	12 hours maximum
Adhesion to Sand Filled Epoxy Polyamine	140 psi
Adhesion of Urethane Topcoats (paintable sealant)	140 psi

NOTES:

- (1) A 2" x 1/2" x 1/2" section of cured sealant shall be immersed and tested:
three samples minimum.

TABLE I
MATERIAL REQUIREMENTS

Table Ib - Epoxy Mortar Flooring System

Test	Minimum Requirement (maximum where indicated)
Compressive Strength (ASTM-C-579)	7,500 psi
Tensile Strength (ASTM-C-307)	1,300 psi
Adhesion to Concrete (ASTM-D-4541) (See Note 1)	400 psi or 100 % failure in concrete
Heat Resistance (continuous exposure)	140°F
Heat Resistance (intermittent exposure)	200°F
Coefficient of Thermal Expansion, 0°F - 210°F (ASTM-C-531)	5.0 - 33.0 x 10 ⁻⁶ in/in°F
Thermal Compatibility between Concrete "Pass" (ASTM-C-884)	
Chemical Resistance to JP-8+100 Fuel @ 70°F (ASTM-D-1308) (See Note 2)	48 hours immersion: 2.0 % (maximum) weight increase, 2.0 % (maximum) thickness increase, 2.0 % (maximum) weight loss
Chemical Resistance to Motor Oils @ 70°F (ASTM-D-1308) (See Note 2)	48 hours immersion: 2.0 % (maximum) weight increase, 2.0 % (maximum) thickness increase, 2.0 % (maximum) weight loss
Chemical Resistance to Skydrols @ 70°F (ASTM-D-1308) (See Note 2)	48 hours immersion: 2.0 % (maximum) weight increase, 2.0 % (maximum) thickness increase, 2.0 % (maximum) weight loss
Lead (ASTM-D-3335)	0.06 % (maximum)
Cadmium (ASTM-D-3335)	0.06 % (maximum)
Chromium (ASTM-D-3718)	0.00 %

NOTES:

- (1) When tested for adhesion, mortar system shall display 400 psi adhesion and/or remove no less than 35 mils of concrete over 95 % of each pull-off coupon throughout service.
- (2) Immediately following immersion, in addition to the listed requirements, mortar system shall be evaluated for blisters, checks, discoloration, softening, and lifting. Mortar system shall visually appear free of blisters, checks, and discoloration, and display both substrate and intercoat adhesion no less than 350 psi (ASTM-D-4541).

TABLE I
MATERIAL REQUIREMENTS

Table Ic - Primer

Test	Minimum Requirement (maximum where indicated)
Resin System (ASTM-D-2621)	Epoxy Polyamine (two-pack)
Percent Volume Solids (ASTM-D-2697)	100 %
Color	Clear to Amber
Hydrolytic Stability (See Note 1)	No effect: 30 days immersion in Sodium Hydroxide solution with pH no less than 13.5
Moisture Insensitivity Throughout Service (ASTM-F-1869, ASTM-D-4541) (See Note 2)	No effect: Insensitive to moisture vapor emission at rates no more than 4.5 lbs moisture/(1000 ft ² , 24 hrs)
Adhesion to Concrete Throughout Service (ASTM-D-4541) (See Note 3)	400 psi or 100 % failure in concrete

NOTES:

- (1) Immediately following immersion, primer shall be evaluated for blisters, checks, discoloration, softening, and substrate lifting. Primer shall visually appear free of blisters, checks, and moderate discoloration, and display wet adhesion no less than 350 psi (ASTM-D-4541).
- (2) During and following application, primer shall remain unaffected by Moisture Vapor Emission (MVE) at rates no more than 4.5 pounds moisture/1000 square feet, 24 hours: primer shall meet the requirements of Note (3). Signs of moisture sensitivity include blisters, softening, lifting, and discoloration (whitening).
- (3) When tested for in-situ adhesion, primer shall display 400 psi adhesion and/or remove no less than 35 mils of concrete over 95 % of each pull-off coupon.

TABLE I
MATERIAL REQUIREMENTS

Table Id - Grout Coat

Test	Minimum Requirement (maximum where indicated)
Resin System (ASTM-D-2621)	Epoxy Polyamine (two-pack)
Percent Volume Solids (ASTM-D-2697)	100 %
Color	17925 (white), or 17875 (ultra-light gray)
Hardness (ASTM-D-2240: Shore D)	80
Adhesion to Epoxy Mortar (ASTM-D-4541)	400 psi

TABLE I
MATERIAL REQUIREMENTS

Table Ie- Urethane Topcoat

Test	Minimum Requirement (maximum where indicated)
Resin System (ASTM-D-2621)	Aliphatic Urethane (two-pack)
Percent Volume Solids (ASTM-D-2697)	52 %
Topcoat Color (Fed. Std. 595B)	17925 (white), or 17875 (ultra-light gray)
Walkway Strip Color: Red/Orange, Semi-gloss (Fed. Std. 595B)	22197 (red/orange)
Application Thickness Per Coat	≤ 3.5 mils Dry Film Thickness (DFT)
Hiding Power: Red/Orange	Complete hiding of white coatings at 2.5 -3.0 mils DFT (one coat)
Sunlight Resistance	Non-yellowing
Heat Resistance (continuous exposure)	140°F
Heat Resistance (intermittent exposure)	200°F
Chemical Resistance to JP-8 +100 Fuel @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 1.0 % (maximum) weight increase, 1.0 % (maximum) thickness increase, 1.0 % (maximum) weight loss
Chemical Resistance to Motor Oils @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 1.0 % (maximum) weight increase, 1.0 % (maximum) thickness increase, 1.0 % (maximum) weight loss
Chemical Resistance to Skydrols @ 70°F (ASTM-D-1308) (See Note 1)	48 hours immersion: 1.0 % (maximum) weight increase, 1.0 % (maximum) thickness increase, 1.0 % (maximum) weight loss

NOTES:

- (1) Immediately following immersion, in addition to the listed requirements, urethane topcoat shall be evaluated for blisters, checks, discoloration, softening, and lifting. Urethane topcoat shall visually appear free of blisters, checks, and discoloration, and display adhesion no less than 350 psi (ASTM-D-4541).

TABLE II
PREAPPROVED MATERIALS*

<u>VENDORS</u>	<u>MATERIALS</u>	
Stonhard (856) 779 - 7500	Primer: Epoxy Mortar: Grout Coat: Topcoat: Sealant:	Standard Primer Stonclad GS Stonkote GS4 Stonseal GS6 Vulkem 245
Polyspec (281) 397 - 0033	Primer: Epoxy Mortar: Grout Coat: Topcoat: Sealant:	300EX Tuffrez 200 Tuffrez 203 Tuffrez 235 T-2235SL
Tennant (800) 553 - 8033	Primer: Epoxy Mortar: Grout Coat: Topcoat: Sealant:	Eco-MPE Eco-PT 250 Eco-PT VOC-CRU N/A**
Crawford Labs (800) 356 - 7625	Primer: Epoxy Mortar: Grout Coat: Topcoat: Sealant:	Florock 4700 Florock 4700 Florock 4700 Florock Super CRU N/A**
General Polymers (800) 543 - 7694	Primer: Epoxy Mortar: Grout Coat: Topcoat: Sealant:	#3578, Universal Primer #3562, Mortar Binder Resin #3744GP, Novo-Flo Pigmented Grout #4618, Polyurethane Enamel Cor-Seal PS

NOTES:

*Other products may meet specification requirements. Up to specification's date of issue, preapproved materials met specification requirements. It is the users' responsibility to confirm preapproved material formulations have not changed and specification requirements will be met. **Polyspec T-2235SL sealant may be used.

APPENDIX A

INSTRUCTIONS FOR MODIFYING SECTION 01450 TO ADD NACE INSPECTOR

Modify Section 01450 to include NACE Coating Inspector as follows:

1. In the Article entitled "SUBMITTALS," add submittal requirement "SD-07 Certificates," add "NACE Coating Inspector; G," and add the following paragraph below the addition of "NACE Coating Inspector; G."

Submit documentation confirming each coating inspector is classified no less than "Intermediate" Coating Inspector under the National Association of Corrosion Engineers (NACE) Coating Inspector Program (NACE CIP) and has successfully completed, as a minimum, "Session III" of NACE CIP. Include NACE Coating Inspector identification number, date of qualification, expiration date, and copy of "Session III" certificate or copy of "NACE Certified" certificate. The NACE Coating Inspector shall work directly for the prime construction contractor and work as part of the prime's Quality Control (QC) Organization. Each NACE Coating Inspector with prior and/or current business relations to job site subcontractors, material suppliers, and equipment suppliers, shall automatically be disqualified. Submit documentation confirming NACE Coating Inspectors have met the aforementioned requirements over the past two years.

2. Add the following table to the Article entitled "QC Specialists Duties and Qualification:"

<u>Qualification/Experience in Area of Responsibility</u>	<u>Area of Responsibility</u>	<u>Frequency</u>
NACE Coating Inspector	Surface preparation, flooring system installation, field tests, and field inspection.	Full time during surface preparation, flooring system installation, field tests, and field inspection.

3. Use NACE Coating Inspector on all flooring projects or, as a minimum, on flooring projects with greater than 2,500 square feet.